



**ABBREVIATED SAMPLING AND ANALYSIS PLAN
FOR ST. LAWRENCE CEMETARY DUMP SITE**

TDD#:	0001/S05-0001-1404-002
EPA OSC:	Betsy Nightingale
SITE NAME:	St. Lawrence Cemetery Dump
SITE LOCATION:	5291 Auburn Rd, Shelby Township, Michigan 48317
SAMPLING ACTIVITIES:	Removal Assessment
SAMPLING DATES:	6/11/14
SAP PREPARER:	Andie Atkins
QC REVIEWER:	John Dirgo
Document Tracking Number	0011

OBJECTIVE OF SAMPLING: At the St. Lawrence Cemetery Dump site (Figure 1 and Figure 2), Tetra Tech plans to: (1) conduct X-ray fluorescence screening on surface soils across the site, (2) collect surface soil samples from a subset of these screening locations, (3) assess the landfill cap for leachate seeps, and (4) collect leachate samples and co-located sediment samples from areas where leachate is seeping from the landfill.

The objective of the surface soil investigation is to determine concentrations of lead and arsenic across the site. The objective of the leachate and co-located sediment sampling investigation on and around the site is to determine location of leachate seeps, establish the chemical characteristics of that leachate, locate potential source areas, and assess the impact of leachate to surface water. It should be noted that a leachate collection system is not currently installed on the landfill and currently only a surface leachate investigation and sampling study is being conducted. Additional leachate sampling may be conducted on both surface and subsurface leachate in the future if data gaps are identified after this Phase I investigation.

SAMPLING METHODS: START, along with EPA FIELDS, will conduct a gridded assessment over the site. A 20-point grid will be placed over the site. This information will be uploaded to a GPS unit and the assessment will be conducted over the site using an XRF unit to field screen site soils. Of these 20 locations, START will collect up to 10 samples with the highest screening levels for arsenic and lead.

Sampling grid locations will be recorded in the field using a GPS device. Soil samples will be collected in accordance with Tetra Tech SOP No. 005-2, "Soil Sampling". (SOPs are included as an attachment to this Abbreviated Sampling and Analysis Plan). One background soil sample will also be collected.

Locations for surface soil samples may be prepared for sampling using a steel trowel to loosen the topsoil, if needed. Surface soil samples will be collected from the prepared sampling location from 0 to 3 inches bgs using a dedicated plastic scoop. The soil will be placed into a dedicated aluminum pan and homogenized before the sample is transferred into a labeled 8-ounce glass jar. The geographic location of each soil sample will be recorded with a GPS device. All soil samples will be analyzed for target analyte list (TAL) metals (including mercury).



START anticipates collecting leachate samples from up to five locations. The leachate assessment will be completed across the entire site and additional samples will be collected if needed. Actual sampling locations will be determined based on field conditions and observations made at the time of sampling. If no seeps are observed during field activities, no leachate samples will be collected and leachate sampling may be attempted again in the future. Leachate samples will be collected directly from the seeps into the appropriate bottleware. A glass transfer bottle may be used to collect the pre-preserved VOC samples.

Leachate samples from each location will be analyzed for target compound list (TCL) VOCs, TCL SVOC, TAL metals, mercury, cyanide, pesticides, PCBs, COD, pH, TDS, TSS, oil and grease, chlorides, nitrate, nitrite, ammonia, total phosphorus, sulfides, and BOD (if leachate volume is not sufficient, samples should be collected in the order specified above). Samples will be poured directly into appropriate containers (see Table 2). Samples will be immediately placed in an iced cooler and maintained at a temperature of $4 \pm 2^{\circ}\text{C}$ without freezing until they are delivered to the laboratory under standard COC protocol.

Following the completion of leachate sampling, START will collect co-located sediment samples from the leachate sampling locations (including one background sample), if sufficient sediment is in place for an adequate sample to be collected. START will collect up to 6 sediment samples. It should be noted that one sediment sample should be collected along with one aqueous leachate samples for every major drainage location where the following conditions exist: presence of leachate, apparent erosional patterns allowing leachate to migrate, and areas of stressed vegetation. Samples may be composited (except those collected for VOC analysis) if they are comprised of material collected within the same general area. Actual sampling locations will be determined based on field conditions and observations made at the time of sampling. The sediment samples will be collected in accordance with Tetra Tech SOP No. 006-4.

Sediment samples will be analyzed for TCL VOCs, TAL metals (including mercury), pesticides/PCBs, and TCL SVOCs. The sediment will be collected from the top 6 inches of the sediment column with a disposable trowel from a submerged location. START will first collect the sample for VOC analysis by placing the sediment directly in a 4-ounce jar with septum using a disposable polyethylene scoop. After collecting the sample for VOC analysis, START will collect additional sediment that will be homogenized and drained in a disposable aluminum pan prior to placement in sample jars to be analyzed for SVOCs, pesticides/PCBs, and TAL metals. Samples will be immediately placed in an iced cooler and maintained at a temperature of $4 \pm 2^{\circ}\text{C}$ without freezing until they are delivered to the laboratory under standard COC protocol.

START will also collect one field duplicate sample for every 20 samples. START will also collect one aqueous trip blank sample per cooler for VOC analysis.

SAMPLE HANDLING: Sampling locations will be noted in the site logbook in accordance with Tetra Tech SOP No. 024, "Recording of Notes in Field Logbook." The collected samples will be labeled, packaged, and shipped in accordance with procedures outlined in Worksheets #26 and 27 of Tetra Tech's START QAPP.

QUALITY ASSURANCE/QUALITY CONTROL: Field QA/QC measures include the collection of one duplicate sample from each medium (soil, leachate, and sediment) and one trip blank sample (for VOC analysis). The trip blank sample will consist of sample containers filled with organic-free water. See Worksheet #20 of Tetra Tech's START QAPP (Tetra Tech 2014) for details. EPA FIELDS will be responsible for calibration of the XRF unit used to field screen surface soils. The Tetra Tech project manager, Ms. Lori Kozel, will be responsible for ensuring that sample quality and integrity are maintained and that sample label and documentation procedures are in accordance with the QAPP.



DECONTAMINATION: All sampling equipment using during this sampling event will be dedicated. The used dedicated, disposal sampling equipment and personal protective equipment (PPE) will be double-bagged and disposed of as dry, industrial waste.

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(Continued)**

TABLE 1: SAMPLE SUMMARY

Matrix	Parameter	Number of Investigative Samples	Number of Quality Control (QC) Samples ^a				Number of Investigative and QC Samples
			Field Duplicate	MS/MSD	Equipment Blank	Trip Blank	
Leachate	TCL VOCs	5	1	0	0	1	7
Leachate	TCL SVOCs/ Pesticides/ PCBs	5	1	0	0	0	6
Leachate	TAL Metals (including mercury)	5	1	0	0	0	6
Leachate	Cyanide	5	1	0	0	0	6
Leachate	COD	5	1	0	0	0	6
Leachate	TDS/TSS, pH	5	1	0	0	0	6
Leachate	Oil and Grease	5	1	0	0	0	6
Leachate	Chlorides/ Nitrate/ Nitrite	5	1	0	0	0	6
Leachate	BOD	5	1	0	0	0	6
Leachate	Ammonia/ Total Phosphorous	5	1	0	0	0	6
Leachate	Sulfides	5	1	0	0	0	6
Sediment	TCL VOCs	5	1	0	0	0	6
Sediment	TCL SVOCs/ Pesticides/ PCBs	5	1	0	0	0	6
Sediment	TAL Metals (including mercury)	5	1	0	0	0	6
Soil	TAL Metals (including mercury)	10	1	1	0	0	12

Note:

a See START QAPP Worksheet #20 for QC sample requirements.

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TABLE 2: ANALYTICAL METHODS

Matrix	Parameter	Concentration Level^a	Analytical Method	Volumes and Containers	Preservation	Holding Time^b
Leachate	TCL VOCs	Low	SW846 8260B	Three 40-mL glass vials with Teflon [®] -lined septum and open-top screw caps	No headspace; cool to 4 °C ± 2 °C; adjust pH to less than 2 with HCl	7 days/14 days
Leachate	TCL SVOCs/ Pesticides/ PCBs	Low (SVOCs), NA (Pesticides and PCBs)	SW846 8270D SW846 8081B SW846 8082A	Six 1-liter amber glass bottles fitted with Teflon-lined screw caps	Cool to 4 °C ± 2 °C immediately after collection	7 days/40 days
Leachate	TAL Metals (including mercury)	ICP-AES, CVAA	SW846 6020/7470A	One 1-liter high density polyethane (HDPE) bottle with polyethylene-lined caps	Acidify to pH < 2 with HNO ₃ and cool to 4 °C (±2 °C) immediately after collection	6 months 28 days (mercury)
Leachate	CN	NA	SW846 9012B	One 500 milliliter high-density polyethylene bottle with polyethylene-lined caps	Add NaOH to pH>12 and cool to 4 °C (±2 °C) immediately after collection	14 days
Leachate	COD	NA	EPA 410.4/ SM5220B	One 250-mL HDPE bottle with polyethylene-lined cap	Acidify to pH < 2 with H ₂ SO ₄ and cool to 4 °C (±2 °C) immediately after collection	28 days
Leachate	BOD	NA	EPA 405.1/ SM5210B	One 500-mL HDPE bottle with polyethylene-lined cap	Cool to 4 °C ± 2 °C immediately after collection	48 hours
Leachate	TDS/TSS, pH	NA	SM 2540C SM 2540D	One 1-liter HDPE bottle with polyethylene-lined cap	Cool to 4 °C ± 2 °C immediately after collection	7 days
Leachate	Oil and Grease	NA	EPA 1664	Two 1-liter CWM glass bottles	H ₂ SO ₄ to pH < 2 and cool to 4±2°C immediately after collection	28 days

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Matrix	Parameter	Concentration Level ^a	Analytical Method	Volumes and Containers	Preservation	Holding Time ^b
Leachate	Chlorides/ Nitrate/ Nitrite	NA	EPA 300	Two 1-liter HDPE bottle with polyethylene-lined cap	Cool to 4±2°C immediately after collection	28 days (Chloride) 48 hours (Nitrite and Nitrate)
Leachate	Total Phosphorous/ Ammonia	NA	SM 4500-NH3, EPA 365	One 500-mL HDPE bottle with polyethylene-lined cap	H2SO4 to pH < 2 and cool to 4±2°C immediately after collection	28 days
Leachate	Sulfides	NA	SM 4500-S	One 500-mL HDPE bottle with polyethylene-lined cap	Zinc Acetate and NaOH to pH >9 and cool to 4±2°C immediately after collection	7 days
Sediment	TCL VOCs	Low	SW846 8260B	One 4-oz glass jar with PTFE-lined septa and open-top screw caps	Cool to 4 °C ± 2 °C immediately after collection	14 days
Sediment	TCL SVOCs/ Pesticides/ PCBs	Low (SVOCs), NA (Pesticides and PCBs)	SW846 8270C SW846 8081B SW846 8082A	Three 8-oz glass jar with polyethylene-lined cap	Cool to 4 °C ± 2 °C immediately after collection	14 days/40 days
Sediment	TAL metals (including mercury)	ICP-MS, CVAA	SW846 6020/7471B	One 8-oz glass jar with polyethylene-lined cap	Cool to 4 °C ± 2 °C immediately after collection	180 days for all metals (28 days for mercury)
Soil	TAL Metals (including mercury)	ICP-MS, CVAA	SW846 6020/7471B	One 8-oz glass jar with polyethylene-lined cap	Cool to 4 °C ± 2 °C immediately after collection	180 days for all metals (28 days for mercury)

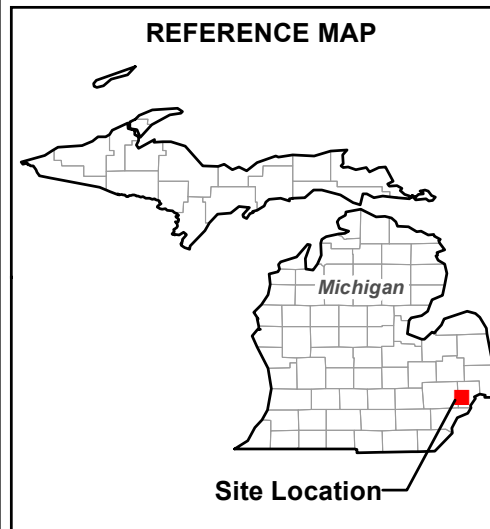
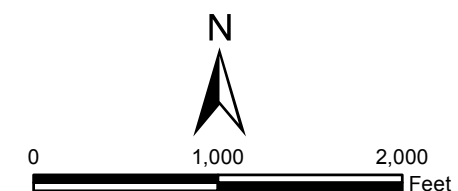
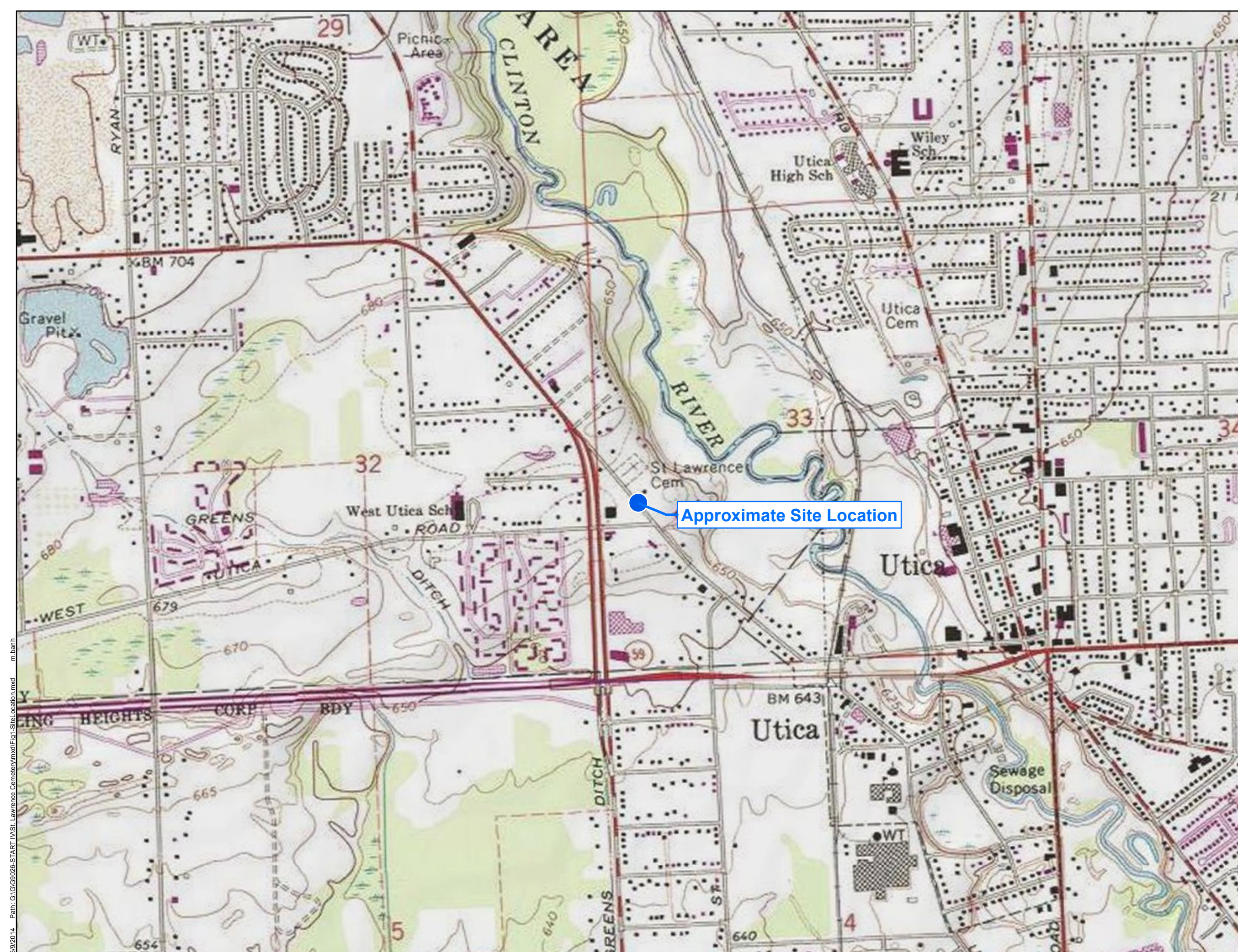
Notes:

a See START QAPP Worksheet #15 for reporting limits

b Holding time is measured from the time of sample collection to the time of sample extraction and analysis

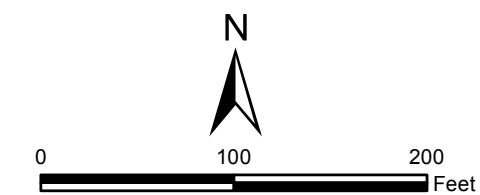
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Figures



ST. LAWRENCE CEMETERY
MACOMB COUNTY, MICHIGAN

FIGURE 1
SITE LOCATION MAP



REFERENCE MAP



ST. LAWRENCE CEMETERY
MACOMB COUNTY, MICHIGAN

FIGURE 2
SITE LAYOUT MAP

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(Continued)**

Tetra Tech Standard Operating Procedures

SOP 005

SOP 006

SOP 024

SOP APPROVAL FORM

TETRA TECH EM INC.
ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SOIL SAMPLING

SOP NO. 005

REVISION NO. 2

Last Reviewed: June 2009



Quality Assurance Approved

6-19-09

Date

1.0 BACKGROUND

Soil sampling is conducted for three main reasons: for laboratory chemical analysis, laboratory physical analysis, or visual classification and field screening. These three sampling objectives can be achieved separately or in combination with each other. Sampling locations are typically chosen to provide chemical, physical, or visual information in both the horizontal and vertical directions. A sampling and analysis plan is used to outline sampling methods and provide preliminary rationale for sampling locations. Sampling locations may be adjusted in the field based on the screening methods being used and the physical features of the area.

1.1 PURPOSE

Soil sampling is conducted to determine the chemical, physical, and visual characteristics of surface and subsurface soils.

1.2 SCOPE

This standard operating procedure (SOP) describes procedures for soil sampling in different areas using various implements. It includes procedures for test pit, surface soil, and subsurface soil sampling, and describes ten soil sampling devices.

1.3 DEFINITIONS

Hand auger: Instrument attached to the bottom of a length of pipe that has a crossarm or “T” handle at the top. The auger can be closed-spiral or open-spiral.

Bucket auger: A type of auger that consists of a cylindrical bucket 10 to 72 inches in diameter with teeth arranged at the bottom.

Core sampler: Thin-wall cylindrical metal tube with diameter of 0.5 to 3 inches, a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve (flutter valve) in the headpiece.

EnCore™ sampler: A disposable volumetric sampling device. It comes in sample sizes of 5 and 25 grams. It is a hermetically sealed, single-use soil sampler made from a high-tech, inert polymer. EnCore™ samplers are used to collect soil samples with zero headspace, as required for volatile organic compound analysis. Each sample is collected using a reusable “T” handle.

Spatulas or Spoons: Stainless steel or disposable instruments for collecting loose unconsolidated material.

Trier: Tube cut in half lengthwise with a sharpened tip that allows for collection of sticky solids or loosening of cohesive soils.

Trowel: Metal or disposable tool with a scooped blade 4 to 8 inches long and 2 to 3 inches wide with a handle.

Split-Spoon (or Split-Barrel) Sampler: Thick-walled steel tube that is split lengthwise. A cutting shoe is attached to the lower end; the upper end contains a check valve and is connected to drill rods.

Thin-Wall Tube Sampler: Steel tube (1 to 3 millimeters thick) with a tapered bottom edge for cutting. The upper end is fastened to a check valve that is attached to drill rods.

Volatile Organics Analysis (VOA) Plunger: Disposable, plastic, single-use soil sample collection device for volatile organic compound sample collection.

1.4 REFERENCES

- U.S. Environmental Protection Agency. (EPA) 1984. “Soil Sampling Quality Assurance Users Guide.” EPA 600/4-84-043.
- EPA. 1980. “Samplers and Sampling Procedures for Hazardous Waste Streams.” EPA 600/2-80-018. January.
- EPA 1983. “Preparation of Soil Sampling Protocol: Techniques and Strategies.” EPA 600/4-83-020.
- EPA. 1987. “A Compendium of Superfund Field Operations Methods.” OSWER Directive 9355.0-14 (EPA/540/P-87/001).

EPA. 1991. “Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells.” March. EPA/600/4-89/034.

EPA. 1994. “Soil Sampling.” Environmental Response Team SOP #2012 (Rev. #0.0, 11/16/94).
<http://www.ert.org/mainContent.asp?section=Products&subsection=List>

EPA. 1996. SW-846, Method 5035, Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples. December.
<http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/5035.pdf>

1.5 REQUIREMENTS AND RESOURCES

Soil sampling requires the use of one or more of the following types of equipment:

- Spoons and spatulas
- Trowel
- Shovel or spade
- Trier
- Core sampler
- EnCore™ sampler
- VOA Plunger
- Hand auger
- Bucket auger
- Split-spoon
- Thin-wall tube

In addition, the following equipment is also needed for various methods:

- Sample containers, labels, and chain-of-custody forms
- Logbook
- Tape for measuring recovery
- Soil classification information
- Wax or caps for sealing ends of thin-wall tube
- “T” Handles
- Plastic sheeting
- Decontamination equipment
- Drilling equipment
- Backhoe
- Health and safety equipment

2.0 SOIL SAMPLING PROCEDURES

This SOP presents procedures for conducting test pit, surface soil, and subsurface soil sampling. The site sampling plan will specify which of the following procedures will be used.

Soil samples for chemical analysis should be collected in the following order: (1) volatile organics, (2) semivolatile organics, and (3) metals. Once the chemical samples have been containerized, samples for physical analyses can be containerized. Typical physical analyses conducted include (1) grain size distribution, (2) moisture content, (3) saturated permeability, (4) unsaturated permeability, and (5) Atterberg limits. Additionally, visual descriptions of samples, using the Unified Soil Classification System (USCS), should be recorded. Field tests such as head space analyses can also be conducted.

Soil samples for chemical analyses can be collected either as grab samples or composite samples. A grab sample is collected from a discrete location or depth. A composite sample consists of soil combined from more than one discrete location. Typically, composite samples consist of soil obtained from several locations and homogenized in a stainless steel or Teflon[®] pan, tray, or baggie. Refer to the site-specific Quality Assurance Project Plan (QAPP) for methodology for composite sample collection. Samples for volatile organics analysis should not be composited.

All soil samples collected should be packaged and shipped to the laboratories in accordance with SOP 019. All nondedicated or nondisposable equipment used for soil sampling should be decontaminated between sampling locations in accordance with SOP 002.

2.1 SOIL SAMPLE COLLECTION PROCEDURES

Soil samples can be collected as discrete samples for volatile organic compound (VOC) analysis using specialized equipment for preservation in the laboratory or in the field. Soil samples collected for non-VOC analysis can be collected as either grab or composite samples using standard equipment.

2.1.1 Procedure for Preserving and Collecting Soil Samples for VOC analysis

Samples collected for VOC analysis using traditional methods, such as collection in a jar with no preservation, are shown to yield nonrepresentative samples due to loss of VOCs. To prevent such losses,

preservation with methanol or sodium bisulfite may be used to minimize volatilization and biodegradation. This preservation may be performed in the laboratory or in the field, depending on the sample collection methodology used. The specific sampling methodology will be specified in the project-specific QAPP or work plan.

Soil samples to be preserved in the laboratory are collected using SW-846 Method 5035. For samples preserved in the field, laboratories may perform low-level analysis (sodium bisulfate preservation) or high- to medium-level analyses (methanol preservation), depending on the project-specific QAPP.

The following procedures outline the necessary steps for collecting soil samples to be preserved at the laboratory, and for collecting soil samples to be preserved in the field with methanol or sodium bisulfate.

2.1.1.1 Soil Samples to be Preserved at the Laboratory

Soil samples collected for VOC analysis that are to be preserved at the laboratory shall be obtained using a hand-operated, hermetically sealed sample vial such as an EnCore™ sampler. Each sample shall be obtained using a reusable sampling handle (“T” handle) that can be provided with the EnCore™ sampler when requested and purchased. Collect the soil sample in the following manner for each EnCore™ sampler.

The EnCore™ sampler is loaded into the “T” handle with the plunger fully depressed. Press the “T” handle into the soil to be sampled. The plunger will be forced upward as the cavity fills with soil. When the sampler is full, using the “T” handle, rotate the plunger and lock it into place. If the plunger does not lock, then it is not filled with soil. Soft soil may require several plunges or forcing soil against a hard surface such as a decontaminated sample trowel to ensure headspace has been eliminated. Remove soil from the outside of the sampler so a tight seal can be made between the sample cap and the O-ring. With soil slightly piled above the rim of the sampler, force the cap on until the catches hook the side of the sampler. Remove any surface soil from outside of the sampler and place in the foil bag provided with the sampler. Label the bag with sample location information. Typically, collect three EnCore™ samplers per sample location. Decontaminate the “T” handle between sample locations.

Using the EnCore™ sampler eliminates the need for field preservation and the shipping restrictions associated with preservatives. A complete set of instructions is included with each EnCore™ sampler.

After the EnCore™ samples are collected, they should be placed on ice immediately and delivered to the laboratory within 48 hours. The samples must be preserved by the laboratory within 48 hours of collection.

2.1.1.2 Soil Samples to be Preserved in the Field

Soil samples preserved in the field may be prepared for analysis using both the low-level (sodium bisulfate preservation) and high- to medium-level (methanol preservation) methods. If samples effervesce when placed in preservative, it is necessary to collect a sample unpreserved, in deionized water. In addition, an unpreserved sample for determination of moisture content must also be collected when collecting soil samples to be preserved in the field.

Methanol Preservation (High to Medium Level). Bottles may be pre-spiked with methanol in the laboratory or prepared in the field. Soil samples to be preserved in the field with methanol shall utilize 40- to 60-milliliter (mL) glass vials with septum-lined lids. Each sample bottle shall be filled with 25 mL of demonstrated analyte-free purge-and-trap grade 3 methanol. The preferred method for adding methanol to the sample bottle is by removing the lid and using a pipette or scaled syringe to add the methanol directly to the bottle.

Soil shall be collected with the use of a decontaminated (or disposable), small-diameter coring device such as a disposable VOA plunger. The outside diameter of the coring device must be smaller than the inside of the sample bottle neck. To collect the sample, pull the plunger back to the required location, insert it into the soil to be sampled, push the coring device into the soil, extrude the soil sample into the methanol-preserved sample bottle, and cap the bottle tightly. Swirl the sample (do not shake) in the methanol to break up the soil such that all of the soil is covered with methanol. Place the sample on ice immediately.

Sodium Bisulfate Preservation (Low Level). Bottles may be prepared in the laboratory or in the field with sodium bisulfate solution. Samples to be field-preserved using sodium bisulfate are collected using the same procedures described for methanol preservation.

2.1.2 Procedure for Collecting Soil Samples for Non-VOC Analyses

Samples collected for non-VOC analyses may be collected as either grab or composite samples as follows. Using a sampling device, transfer a portion of soil to be sampled to a stainless steel bowl, disposable inert plastic tray, or baggie. Remove roots, vegetation, sticks, and stones larger than the size of pea gravel. Thoroughly mix the soil to obtain as uniform a texture and color as practicable. Transfer the mixed soil to the appropriate sample containers and close the containers. Place the sample containers immediately on ice.

2.2 TEST PIT AND TRENCH SOIL SAMPLING

Test pit and trench soil sampling is conducted when a complete soil profile is required or as a means of locating visually detectable contamination. This type of sampling provides a detailed description of the soil profile and allows for multiple samples to be collected from specific soil horizons. Prior to conducting any test pit or trench excavation with a backhoe, the sampling team should ensure that the sampling area is clear of utility lines, subsurface pipes, and poles.

A test pit or trench is excavated by incrementally removing soil material with a backhoe bucket. The excavated soil is placed on plastic sheeting well away from the edge of the test pit. A test pit should not be excavated to depths greater than 4 feet unless its walls are properly sloped or stabilized. No personnel shall enter any test pit or trench excavation over 4 feet deep; such action would constitute confined space entry and must conform with Occupational Safety and Health Administration (OSHA) regulations at Title 29 of the *Code of Federal Regulations* § 1910.

Personnel entering the test pit may be exposed to toxic or explosive gases and oxygen deficient environments. Air monitoring is required before entering the test pit, and the use of appropriate respiratory gear and protective clothing is mandatory. At least two persons must be present at the test pit before sampling personnel may enter the excavation and begin soil sampling. Refer to project-specific Health and Safety Plans for required safety procedures for excavations.

Soil samples can also be obtained directly from the backhoe bucket or from the excavated material after it has been removed and deposited on plastic sheeting. The sampling personnel shall direct the backhoe excavator to obtain material from the selected depth and location within the excavation. The backhoe

operator shall set the backhoe bucket on the ground in a designated location, at a sufficient distance from the excavation to allow the sampler safe access to the bucket. The backhoe operator shall disengage the controls and signal to the sampler that it is safe to approach the bucket. The soil sample shall then be collected from the center of the backhoe bucket to reduce the potential for cross-contamination of the sample.

Test pits are not practical for sampling at depths greater than 15 feet. If soil samples are required from depths greater than 15 feet, samples should be obtained using test borings instead of test pits. Test pits are also usually limited to a few feet below the water table. In some cases, a pumping system may be required to control the water level within the pits.

Access to open test pits should be restricted by the use of flagging, tape, or fencing. If a fence is used, it should be erected at least 6 feet from the perimeter of the test pit. The test pit should be backfilled as soon as possible after sampling is completed.

Various equipment may be used to collect soil samples from the walls or bottom of a test pit. A hand auger, bucket auger, or core sampler can be used to obtain samples from various depths. A trier, trowel, EnCore™ sampler, VOA plunger, or spoon can be used to obtain samples from the walls or pit bottom surface.

2.3 SURFACE SOIL SAMPLING

The surface soil sampling equipment presented in this SOP is best suited for sampling to depths of 0 to 6 feet below ground surface (bgs). The sample depth, sample analyses, soil type, and soil moisture will also dictate the most suitable sampling equipment. Prior to sample collection, the sampling locations should be cleared of any surface debris such as twigs, rocks, and litter. The following table presents various surface soil sampling equipment and their effective depth ranges, operating means (manual or power), and sample types collected (disturbed or undisturbed).

Sampling Equipment	Effective Depth Range (feet bgs)	Operating Means	Sample Type
Hand Auger	0 to 6	Manual	Disturbed
Bucket Auger	0 to 4	Power	Disturbed
Core Sampler	0 to 4	Manual or Power	Undisturbed
EnCore™ Sampler	Not Applicable	Manual	Disturbed
Spoon/Spatula	0 to 0.5	Manual	Disturbed
Trowel	0 to 1	Manual	Disturbed
VOA Plunger	Not Applicable	Manual	Disturbed

The procedures for using these various types of sampling equipment are discussed below.

2.3.1 Hand Auger

A hand auger equipped with extensions and a “T” handle is used to obtain samples from depths of up to 6 feet bgs. If necessary, a shovel may be used to excavate the topsoil to reach the desired subsoil level. If topsoil is removed, its thickness should be recorded. Samples obtained using a hand auger are disturbed in their collection; determining the exact depth at which samples are obtained is difficult.

The hand auger is screwed into the soil at an angle of 45 to 90 degrees from horizontal. When the entire auger blade has penetrated soil, the auger is removed from the soil by lifting it straight up without turning it, if possible. If the desired sampling depth has not been reached, the soil is removed from the auger and deposited onto plastic sheeting. This procedure is repeated until the desired depth is reached and the soil sample is obtained. The auger is then removed from the boring and the soil sample is collected directly from the auger into an appropriate sample container.

2.3.2 Bucket Auger

A bucket auger, equipped similarly as the hand auger, is used to obtain disturbed samples from depths of up to 4 feet bgs. A bucket auger should be used when sampling stony or dense soil that prohibits the use of a hand-operated core or screw auger. A bucket auger with closed blades is used in soil that cannot generally be penetrated or retrieved by a core sampler.

The bucket auger is rotated while downward pressure is exerted until the bucket is full. The bucket is then removed from the boring, the collected soil is placed on plastic sheeting, and this procedure is repeated until the appropriate depth is reached and a sample is obtained. The bucket is then removed from the boring and the soil sample is transferred from the bucket to an appropriate sample container.

2.3.3 Core Sampler

A hand-operated core sampler (Figure 1), similarly equipped as the hand auger, is used to obtain samples from depths of up to 4 feet bgs in uncompacted soil. The core sampler is capable of retrieving undisturbed soil samples and is appropriate when low concentrations of metals or organics are of concern. The core sampler should be constructed of stainless steel. A polypropylene core sampler is generally not suitable for sampling dense soils or sampling at greater depths.

The core sampler is pressed into the soil at an angle of 45 to 90 degrees from horizontal and is rotated when the desired depth is reached. The core is then removed, and the sample is placed into an appropriate sample container.

2.3.4 Shovel

A shovel may be used to obtain large quantities of soil that are not readily obtained with a trowel. A shovel is used when soil samples from depths of up to 6 feet bgs are to be collected by hand excavation; a tiling spade (sharpshooter) is recommended for excavation and sampling. A standard steel shovel may be used for excavation; either a stainless steel or polypropylene shovel may be used for sampling. Soil excavated from above the desired sampling depth should be stockpiled on plastic sheeting. Soil samples should be collected from the shovel and placed into the sample container using a stainless-steel scoop, plastic spoon, or other appropriate tool.

2.3.5 Trier

A trier (Figure 2) is used to sample soil from depths up to 1 foot bgs. A trier should be made of stainless steel or polypropylene. A chrome-plated steel trier may be suitable when samples are to be analyzed for organics and heavy metal content is not a concern.

Samples are obtained by inserting the trier into soil at an angle of up to 45 degrees from horizontal. The trier is rotated to cut a core and is then pulled from the soil being sampled. The sample is then transferred to an appropriate sample container.

2.3.6 Trowel

A trowel is used to obtain surface soil samples that do not require excavation beyond a depth of 1 foot. A trowel may also be used to collect soil subsamples from profiles exposed in test pits. Use of a trowel is practical when sample volumes of approximately 1 pint (0.5 liter) or less are to be obtained. Excess soil should be placed on plastic sheeting until sampling is completed. A trowel should be made of stainless steel or galvanized steel. It can be purchased from a hardware or garden store. Soil samples to be analyzed for organics should be collected using a stainless steel trowel. Samples may be placed directly from the trowel into sample containers.

2.4 SUBSURFACE SOIL SAMPLING

Subsurface soil sampling is accomplished in conjunction with borehole drilling, for soil sampling from depths greater than approximately 6 feet bgs. Subsurface soil sampling is frequently coupled with exploratory boreholes or monitoring well installation.

Subsurface soil sampling may be conducted using a drilling rig, power auger, or direct-push technology (DPT). Selection of sampling equipment depends upon geologic conditions and the scope of the sampling program. Two types of samplers used with machine-driven augers—the split-spoon sampler and the thin-wall tube sampler—are discussed below. All sampling tools should be cleaned before and after each use in accordance with SOP No. 002 (General Equipment Decontamination). Both the split-spoon sampler and the thin-wall tube sampler can be used to collect undisturbed samples from

unconsolidated soils. The procedures for using the split-spoon and thin-wall tube samplers are presented below.

2.4.1 Split-Spoon Sampler

Split-spoon samplers are available in a variety of types and sizes. Site conditions and project needs, such as large sample volume for multiple analyses, determine the specific type of split-spoon sampler to be used. Figure 3 shows a generic split-spoon sampler.

The split-spoon sampler is advanced into the undisturbed soil beneath the bottom of the casing or borehole using a weighted hammer and a drill rod. The relationship between hammer weight, hammer drop, and number of blows required to advance the split-spoon sampler in 6-inch increments indicates the density or consistency of the subsurface soil. After the split-spoon sampler has been driven to its intended depth, it should be removed carefully to avoid loss of sample material. In noncohesive or saturated soil, a catcher or basket should be used to help retain the sample.

After the split-spoon sampler is removed from the casing, it is detached from the drill rod and opened. If VOA samples are to be collected, EnCore™ samplers or VOA plungers should be filled with soil taken directly from the split-spoon sampler. Samples for other specific chemical analyses should be taken as soon as the VOA sample has been collected. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample (except for the top several inches of possibly disturbed material) is retained for analysis or disposal.

2.4.2 Thin-Wall Tube Sampler

A thin-wall tube sampler, sometimes called the Shelby tube (Figure 4), is used to collect soil samples for geophysical analysis. Tube samplers are best suited for collecting cohesive soils such as clays and silts. The tube sampler may be pressed or driven into soil inside a hollow-stem auger flight, wash bore casing, or uncased borehole. The tube sampler is pressed into the soil, without rotation, to the desired depth or until refusal. If the tube cannot be advanced by pushing, it may be necessary to drive it into the soil without rotation using a hammer and drill rod. The tube sampler is then rotated to collect the sample from the soil and removed from the borehole.

After removal of the tube sampler from the drilling equipment, the tube sampler should be inspected for adequate sample recovery. The sampling procedure should be repeated until an adequate soil core is obtained (if sample material can be retained by the tube sampler). The soil core obtained should be documented in the logbook. Any disturbed soil is removed from each end of the tube sampler. If chemical analysis is required, VOA samples must be collected immediately after the tube sampler is withdrawn. EnCore™ samplers or VOA plungers should be filled with soil taken directly from the tube sampler. Before use, and during storage and transport, the tube sampler should be capped with a nonreactive material. For physical sampling parameters, the tube is sealed using plastic caps. The top and bottom of the tube sampler should be labeled and the tube sampler should be stored accordingly.

2.4.3 Direct-Push Technology Sampler

Geoprobe systems utilize DPT. In many cases, DPT is less expensive and faster than collecting soil samples with a standard drilling rig. In addition, the use of DPT causes minimal disturbance to the ground surface and generates little to no soil cuttings. DPT uses acetate or clear polyvinyl chloride (PVC) sleeves for collecting soil samples. Use of the Geoprobe system is described in SOP No. 054.

Upon retrieval of the sampling rod from the ground, the sample sleeve is extruded from the sampling rod. The sleeve is sliced lengthwise twice, to open the sleeve. Soil samples can be collected directly from the opened sleeve. If VOA samples are to be collected, EnCore™ samplers or VOA plungers should be filled with soil taken directly from the opened DPT sampler. Samples for other specific chemical analyses should be taken after the VOA sample has been collected. The remainder of the recovered soil can then be used for visual classification of the sample and containerized for physical analysis. The entire sample is retained for analysis or disposal.

FIGURE 1
HAND-OPERATED CORE SAMPLER

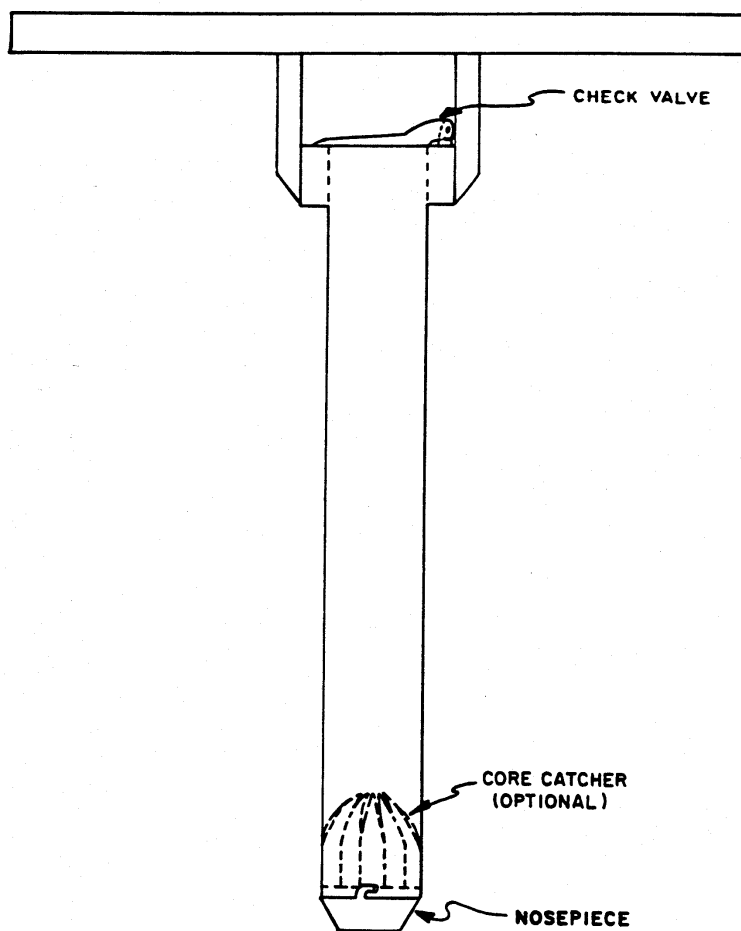


FIGURE 2

TRIER

TRIER

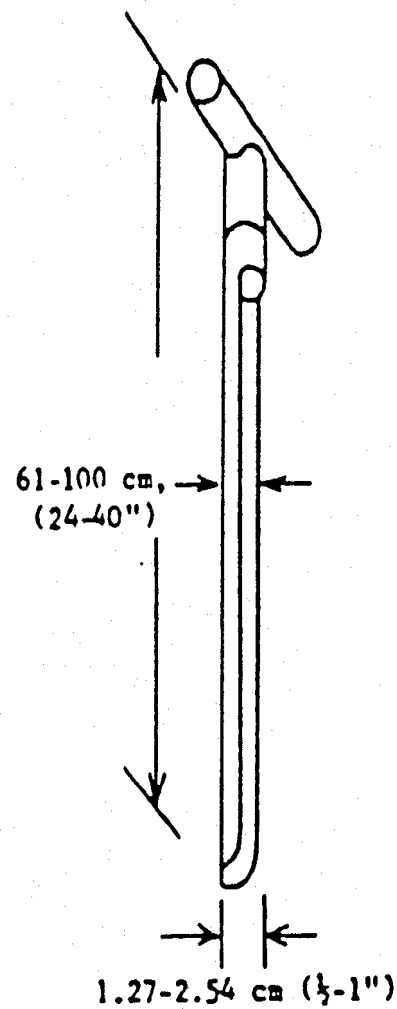


FIGURE 3
GENERIC SPLIT-SPOON SAMPLER

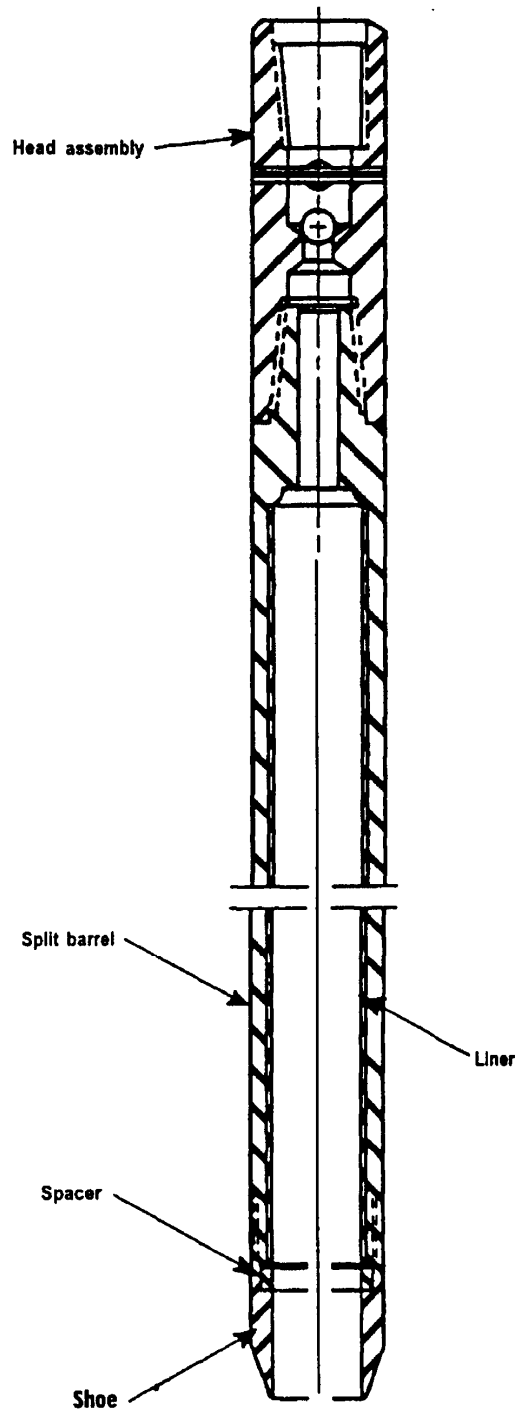
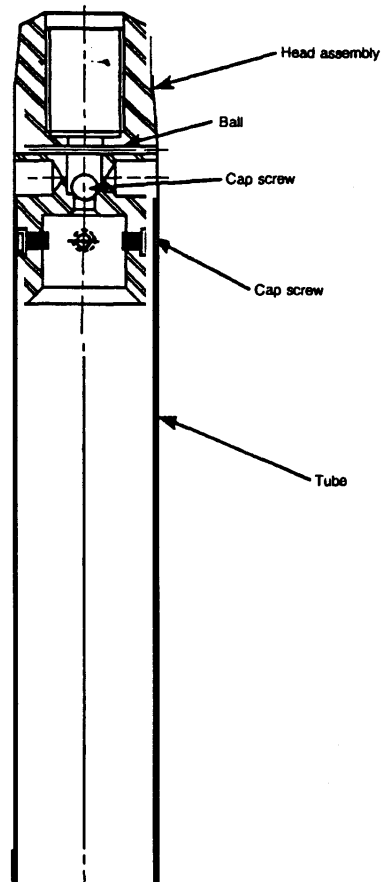


FIGURE 4
THIN-WALL TUBE SAMPLER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

SEDIMENT AND SLUDGE SAMPLING

SOP NO. 006

REVISION NO. 4

Last Reviewed: May 2010



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May 5, 2010

Date

1.0 BACKGROUND

Sediments generally are materials deposited in surface impoundments or in natural waterways such as lakes, streams, rivers, oceans, and sloughs, as well as particulate matter deposited on the marsh or wetland surface.

Sludges are semisolid materials ranging from dewatered solids to high-viscosity liquids. Sludges generally accumulate as residuals of water-bearing waste treatment or industrial process systems. Sludges typically accumulate in tanks, drums, impoundments, or other types of containment systems.

1.1 PURPOSE

This standard operating procedure (SOP) establishes the requirements and procedures for sampling sediment in lakes, streams, and rivers as well as sludge in open drums and shallow tanks (3 feet deep or less) or surface impoundments that are largely accessible. Sludge sampling as it pertains to drums or other containers with smaller or less accessible openings is described in SOP 008..

1.2 SCOPE

This SOP applies to collection of sediment and sludge samples. It provides detailed procedures for gathering such samples with specific equipment.

1.3 DEFINITIONS

Bottom Dredge Grab Sampler: A clamshell-type metal scoop activated by a counter-lever latching system.

Composite Sample: A sample comprised of multiple grab samples representing a physical average of the total number of grab samples.

Discrete Sample: A sample comprised of a portion of material representing conditions present at a single unit of space and time.

Electronic Vibration Corer: A type of sampler that uses an electrically powered vibrating head, which vibrates vertically along the axis of the sampler to penetrate the sediment.

Gravity Corer: Metal tube with a tapered nosepiece on the bottom and a check valve on the top. The nosepiece reduces core disturbance during penetration. The check valve allows air and water to pass through the sampler during deployment and prevents sample loss (washout) during retrieval.

Hand Corer: Thin-wall tube or core barrel sampler. Some models include a tapered nosepiece, a “T” handle to facilitate sampler deployment and retrieval, and a check valve on top. Some models are available with extension handles, core barrel liners, core catchers, and sample extruders.

Transect Sampling: A series of samples collected at several locations oriented in a straight line.

1.4 REFERENCES

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1.5 REQUIREMENTS AND RESOURCES

The selection of sampling equipment and procedures should be based on project objectives and site-specific conditions such as the type and volume of sediment or sludge to be sampled, sampling depth, and the type of sample required (disturbed or undisturbed). The selected sampling equipment should be constructed of inert materials that will not react with the sediment or sludge being sampled.

The following equipment may be required to sample sediment or sludge:

- Plastic sheeting
- Field logbook
- Stainless steel or disposable spoons or spatulas
- Stainless-steel or disposable scoop or trowel
- Stainless-steel bowls
- Telescoping or fixed-length pole/handle for scoop or trowel
- Hip waders, chest waders, or high rubber boots (depending on water depth)
- Boat (depending on water depth)
- Gravity corer
- Hand corer
- Sludge sampler
- Electronic vibration corer
- Bottom dredge sampler
- Stainless-steel or Teflon[®] tray
- Nylon rope
- Sample containers and labels
- Chain-of-custody and shipping materials
- Decontamination materials

2.0 PROCEDURES

This section provides general procedures for sampling sediment and sludge. Sections 2.1 through 2.5 specify the methods and equipment to be used for such sampling.

Sediment Sampling

Sediment can be sampled using a stainless-steel scoop or trowel (see Section 2.1), a hand corer (see Section 2.2), a gravity corer (see Section 2.3), an electronic vibration corer (see Section 2.4), or a bottom dredge grab sampler such as a Ponar grab sampler (see Section 2.5). Soil core catchers and brass, polycarbonate plastic, or Teflon[®] liners are often used with core samplers. A number of factors must be considered when selecting the type of sampler to be used. In streams, lakes, and impoundments, for instance, sediment is likely to demonstrate significant variations in composition.

For stream sediment sampling, the sampling location farthest downstream should be sampled first to avoid cross-contamination. Sediment samples collected in upstream and downstream locations should be obtained in similar depositional environments and, whenever possible, should be obtained from slow-moving pools. In addition, a sediment sample should be collected at approximately the same location as an associated aqueous sample. Aqueous samples should be obtained first to avoid collecting suspended particles that may result from sediment sampling. To avoid disturbing an area to be sampled, sampling locations in streams should always be approached from the downstream side.

Sediment samples collected from lakes and impoundments should also be collected at approximately the same locations as associated aqueous samples. As in stream sampling, aqueous samples should be collected first to avoid collecting suspended particles that may result from sediment sampling.

Downgradient and background samples should be collected from similar depositional environments.

Typically, fine-grained sediments should be targeted as they have greater surface area available for adsorption of contaminants. In streams or rivers, low-velocity depositional areas (bends, areas behind obstructions, pooling areas) are preferred sampling locations. High velocity turbulent areas should be avoided, if possible. Samples may be collected at a single location, along a transect line, or as composite samples consisting of material from multiple grab samples.

Often times the top 10 centimeters (approximately top six inches) of sediment is targeted as the sample interval because most benthic organisms are found in this horizon. Sampling multiple locations can provide information on the horizontal distribution of contaminants in a given water body. A column of

sediment can provide information on the vertical distribution of contaminants with depth. Sampling locations, the number of samples to be collected, sampling rationale, and sampling approach (grab, transect, composite, etc.) should be discussed in the project-specific plans.

Exact sampling locations should be documented in field logbooks or on data sheets with respect to fixed reference points or located using global positioning satellite (GPS) technology. In addition, the presence of rocks, debris, or organic material in the sludge or sediment to be sampled may preclude use of some types of samplers or require modification of sampling equipment.

Sludge Sampling

Sludge can often be sampled using a stainless-steel scoop or trowel (see Section 2.1). Frequently sludge forms when components with higher densities settle out of a liquid. When this happens, the sludge may still have an upper liquid layer above the denser components. When the liquid layer is sufficiently shallow, the sludge may be sampled using a hand corer (see Section 2.2). Use of the hand corer is preferred because it results in less sample disturbance. The hand corer also allows for the collection of an aliquot of the overlying liquid. This prevents drying or excessive oxidation of a sample before analysis. The hand corer may also be adapted to hold a brass, polycarbonate plastic, or Teflon[®] liner.

A gravity corer may also be used to collect samples of most sludges and sediments (see Section 2.3). A gravity corer is capable of collecting an undisturbed sample that profiles the strata present in a sludge or sediment. Depending on the weight of the gravity corer and the density of the sludge or sediment, a gravity corer may penetrate the material up to 30 inches. If the layer is shallow (less than 1 foot), gravity corer and hand corer penetration may damage any underlying liner or confining layer. In such situations, a Ponar grab sampler may be used because it is generally capable of penetrating only a few inches (see Section 2.4).

The following subsections specify methods for sediment and sludge sampling with specific equipment.

2.1 SAMPLING WITH A SCOOP OR TROWEL

Sediment or sludge samples may be collected with a simple scoop or trowel. This method is more applicable to sludge but can be used for sediments provided that the water is very shallow (a few inches).

However, using a scoop or trowel may disrupt the water-sediment interface and cause substantial sample alteration. This method provides a simple, quick means of collecting a disturbed sample of sludge or sediment.

The following procedure can be used for sampling sludge or sediment with a scoop or trowel:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Carefully insert a pre-cleaned scoop or trowel into the sludge or sediment and remove the sample. In the case of sludge exposed to air, remove the first 2 to 4 inches of material before collecting the sample. In the case of collecting sediment with abundant debris or vegetation at the surface, carefully remove the debris (avoid disturbing the sediment to the extent possible) before collecting the sample.
4. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, texture, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
5. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
6. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
7. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
8. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
9. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.2 SAMPLING WITH A HAND CORER

The hand corer, sometimes called a hand auger (see Figure 1), is used in the same situations and for the same materials as those described for the use of a scoop or trowel (see Section 2.1). However, the hand

corer may be used to collect an undisturbed sample that can profile any stratification resulting from changes in material deposition thus allowing for sampling of the specific layer or layers of interest.

The exact type of hand corer will vary depending on the manufacturer, but the operational procedures discussed below are applicable to most types of hand corers. For example, some hand corers can be fitted with extension handles that allow collection of samples underlying a shallow layer of liquid. Most hand corers can be fitted with core catchers (Figure 1) to prevent sample loss upon retrieval and they can be adapted to hold liners, which are generally available in brass, polycarbonate plastic, or Teflon®. The type of hand corer and liner material should be chosen that will not compromise the intended analytical procedures.

The following procedure can be used for sampling sludge or sediment with a hand corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Position a pre-cleaned hand corer above the sampling location. If the sediment or sludge is non-cohesive, insert a core catcher into the end of the sampler. Carefully deploy the hand corer into the sludge or sediment using a smooth, continuous motion. Gently rotating the corer while it is being pushed may facilitate greater penetration and decrease core compaction.
4. When the hand corer is at the desired depth, rotate the “T” handle or the core barrel and retrieve the hand corer using a single, smooth motion. If the hand corer does not include a “T” handle, cap the top of the core barrel with your hand to provide additional suction during retrieval.
5. Remove the core catcher and nosepiece (if applicable) and extract the sample. Place the sample on a clean stainless-steel or Teflon® tray. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon® tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.

6. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
7. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
8. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
9. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
10. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.3 SAMPLING WITH A GRAVITY CORER

A gravity corer (see Figure 2) can collect essentially undisturbed samples to profile strata that develop in sediment and sludge during the deposition process. Depending on the sediment or sludge density and the gravity corer's weight, the sampler typically can penetrate the sediment or sludge to a depth of 30 inches, using the weight of the sampler to assist penetration. A gravity corer is lowered into the sediment from a fixed support (such as a boat or a portable tripod pole system).

Gravity corers should be used carefully in open drums, shallow tanks, or lagoons with liners. A gravity corer could penetrate beyond the sludge or sediment layer and damage the liner material.

The following procedure can be used for sampling sediment or sludge with a gravity corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.

3. Attach the required length of sample line to a pre-cleaned gravity corer. Braided, 3/16-inch nylon line is sufficient; however, 3/4-inch nylon line is easier to grasp during hoisting.
4. Secure the free end of the line to a fixed support to prevent accidental loss of the gravity corer.
5. Position the gravity corer above the sampling location. Allow the gravity corer to fall freely through the liquid and penetrate the sludge or sediment layer.
6. Retrieve the gravity corer with a smooth, continuous lifting motion. Do not bump the corer, as this may result in some sample loss.
7. Remove the core catcher and nosepiece (if applicable) from the gravity corer. Slide the sample out of the corer into a stainless-steel or Teflon® pan. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon® tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
8. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
9. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
10. Ensure that a Teflon® liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
11. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
12. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.4 SAMPLING WITH AN ELECTRONIC VIBRATION CORE SAMPLER

Electronic vibration corers are commonly used core samplers because they can retrieve deep core samples in most types of sediment. For example, electronic vibration corers can be used from a boat to collect a sample from the shallow sea floor. Vibration corers typically are not appropriate for sludge sampling as they could penetrate beyond the sludge layer and damage the liner material of a container.

Vibration samplers have an electrically powered vibrating head, which vibrates vertically along the axis of the sampler to penetrate the sediment (Figure 3). The core barrel and liner are inserted into the head of the vibrator and the entire assembly is lowered into the water. A vibrating core sampler can penetrate compact sediments and collect core samples up to 10 meters long depending on the type of system used, the horsepower of the vibrating head, and weight of the sampler.

The two general types of vibrating core systems typically used include larger boat-deployed systems and portable pole systems. Larger vibrating core samplers require the use of an appropriately sized boat to maintain balance and provide adequate lift to break the head of the corer out of the sediment for sample retrieval (EPA 2001).

The following procedure can be used for sampling sediment with a submersible boat-deployed vibration corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location if working next to the shore or stream bank. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Securely attach the vibrating corer assembly to the winch cable.
4. Position the vibrating corer above the sampling location. Using the winch, suspend and lower the corer until the core tube contacts the bottom.
5. Begin vibration and continue penetration until the core tube is fully buried or refusal occurs. Care should be taken to keep the cable taught ensuring that the core tube is vertical. Turn off vibration when coring is completed.

6. Retrieve the vibration corer with the winch, using vibration only if extraction is difficult. Keep the core tube in a near vertical position once retrieved.
7. Remove the core catcher, nosepiece, and liner from the core tube. Cap the ends of the liner, label the liner to identify the location, sample number, time of collection, and date. Transfer the sample on-shore for further processing. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable.
8. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
9. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
10. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
11. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before shipment.
12. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

The following procedure can be used for sampling sediment with a portable pole system vibration corer:

1. Place all sampling equipment on plastic sheeting next to the sampling location if working next to the shore or stream bank. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Securely attach the retrieval lines to the core tube mounting cap.
4. Insert liner tube (core catcher end down) into mounting clamp and hand-tighten wing nuts evenly.

5. Insert desired length extension pole into mounting plate socket and secure with bolt and locknut. Slip flared lower end of the extension tube over the check-valve end of the core tube adapter while applying tension on the retrieval lines. Lower the system carefully until it contacts the bottom.
6. Press and vibrate the core tube until it is fully buried or refusal occurs. Note the depth of penetration by markings on the extension pole. Turn off vibration when coring is completed.
7. Disconnect the extension pole and manually retrieve the vibration corer with the retrieval lines or use a hand winch, if necessary. Keep the core tube in a near vertical position once retrieved.
8. Remove the core catcher, nosepiece, and liner from the core tube. Cap the ends of the liner, label the liner to identify the location, sample number, time of collection, and date. Transfer the sample on-shore for further processing. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
9. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
10. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
11. Ensure that a Teflon[®] liner is present in the sample container cap. Secure the cap tightly on the sample container.
12. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
13. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

2.5 SAMPLING WITH A BOTTOM DREDGE SAMPLER

Bottom dredge samplers are typically used to sample sediments that cannot be easily collected using trowels, scoops, or coring devices or in cases where large quantities of sample are desired. Bottom dredge samples are particularly effective when sampling from a boat where there are several feet of water above the sediment surface. Several types and sizes of dredges exist including the Peterson, Eckman, and Ponar. Dredges can be activated upon contact with the sediment or by using a “messenger” to close the buckets. The procedures discussed below are applicable to sampling with a Ponar dredge sampler. A Ponar grab sampler (see Figure 4) can be used to sample most types of sludges and sediments. A Ponar grab sampler is used by holding the grab sampler above the area to be sampled and lowering the grab sampler until it makes contact with the sediment. Its penetration depth into the sediment usually does not exceed several inches. The Ponar grab sampler, like other grab samplers, cannot collect undisturbed samples; therefore, this sampler should be used only after all overlying water samples have been collected.

The following procedure can be used for sampling sludge or sediment with a Ponar grab sampler:

1. Place all sampling equipment on plastic sheeting next to the sampling location. Sample containers should be selected in accordance with the requirements in SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
2. Affix a completed sample container label to the appropriate sample container.
3. Attach the required length of sample line to a precleaned Ponar grab sampler. Braided, 3/4-inch nylon line is recommended for ease in hoisting.
4. Measure the distance from the water surface or other reference point to the top of the sludge or sediment. Mark this measurement on the sample line. To avoid unnecessary disturbance of the sludge or sediment from lowering the Ponar grab sampler too quickly, it is recommended that a second mark be made on the sample line to indicate the proximity of the reference mark.
5. Open the Ponar sampler’s jaws until they are latched. The jaws will be triggered if the Ponar sampler comes in contact with or is supported by anything other than the sample line. Tie the free end of the sample line to a fixed support.

6. Position the Ponar grab sampler above the sampling location. Lower the sampler until the proximity mark is reached. Then, slowly lower the Ponar grab sampler until it touches and penetrates the sludge or sediment.
7. Allow the sample line to slacken a few inches to release the latching mechanism that closes the sampler's jaws. As the jaws close, they scoop the sludge or sediment up into the sampler. More slack may be required when sampling in surface waters with strong currents.
8. Retrieve the sampler, open the jaws carefully, and release its contents into a stainless-steel or Teflon[®] tray. When compositing a series of grab samples, combine the samples in a stainless-steel bowl or Teflon[®] tray. Record pertinent information in the field logbook (sample description, color, odor, etc.) or in a field data collection form, if applicable. If samples are to be collected for VOC analysis, fill the appropriate VOC containers first before compositing the sample and logging the sample information.
9. Transfer the sample into the labeled container using a stainless-steel or plastic spoon, spatula, or similar tool.
10. If required, preserve the sample in accordance with SOP No. 016, Sample Container, Preservation, and Maximum Holding Time Requirements.
11. Ensure that a Teflon[®] liner is present in the sample container cap, if required. Secure the cap tightly on the sample container.
12. Complete all chain-of-custody documents, field logbook entries, and sample packaging requirements. Samples are typically stored in coolers on ice before and during shipment.
13. Decontaminate all nondisposable sampling equipment after each use and between sampling locations using the procedures in SOP No. 002, General Equipment Decontamination.

FIGURE 1
HAND CORER

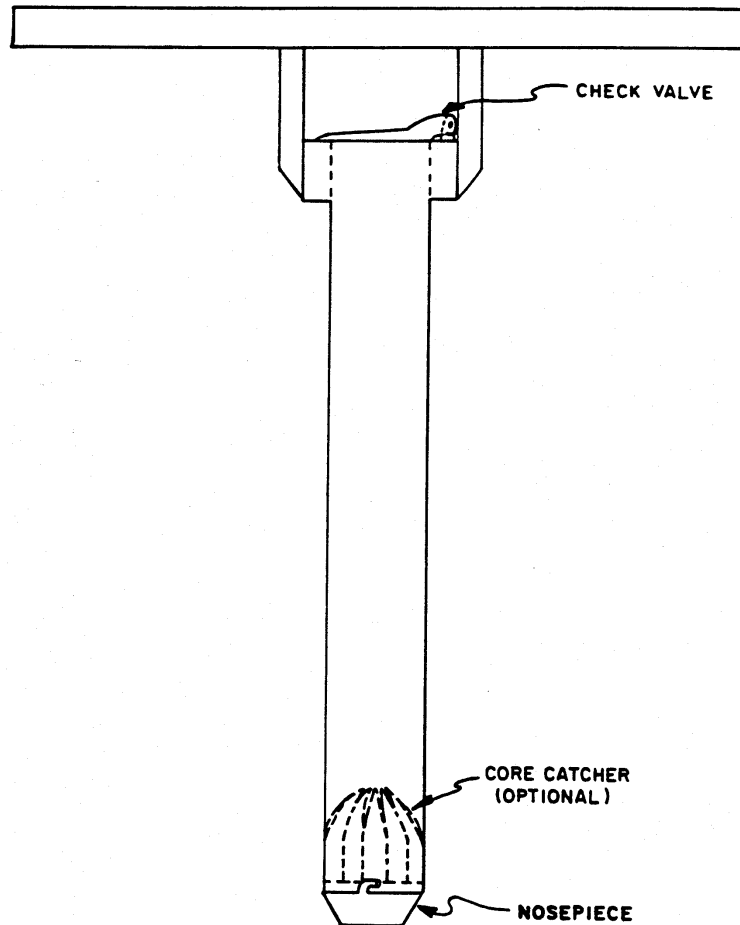


FIGURE 2
GRAVITY CORER

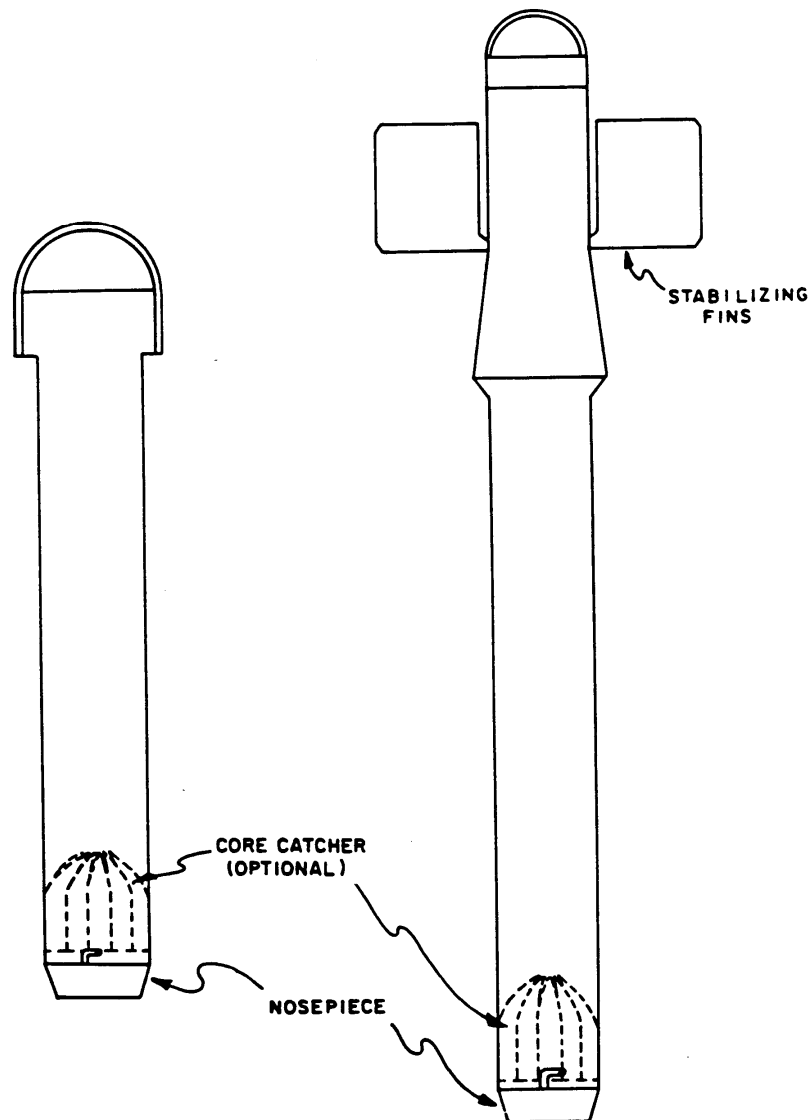


FIGURE 3
VIBRACORE SAMPLER

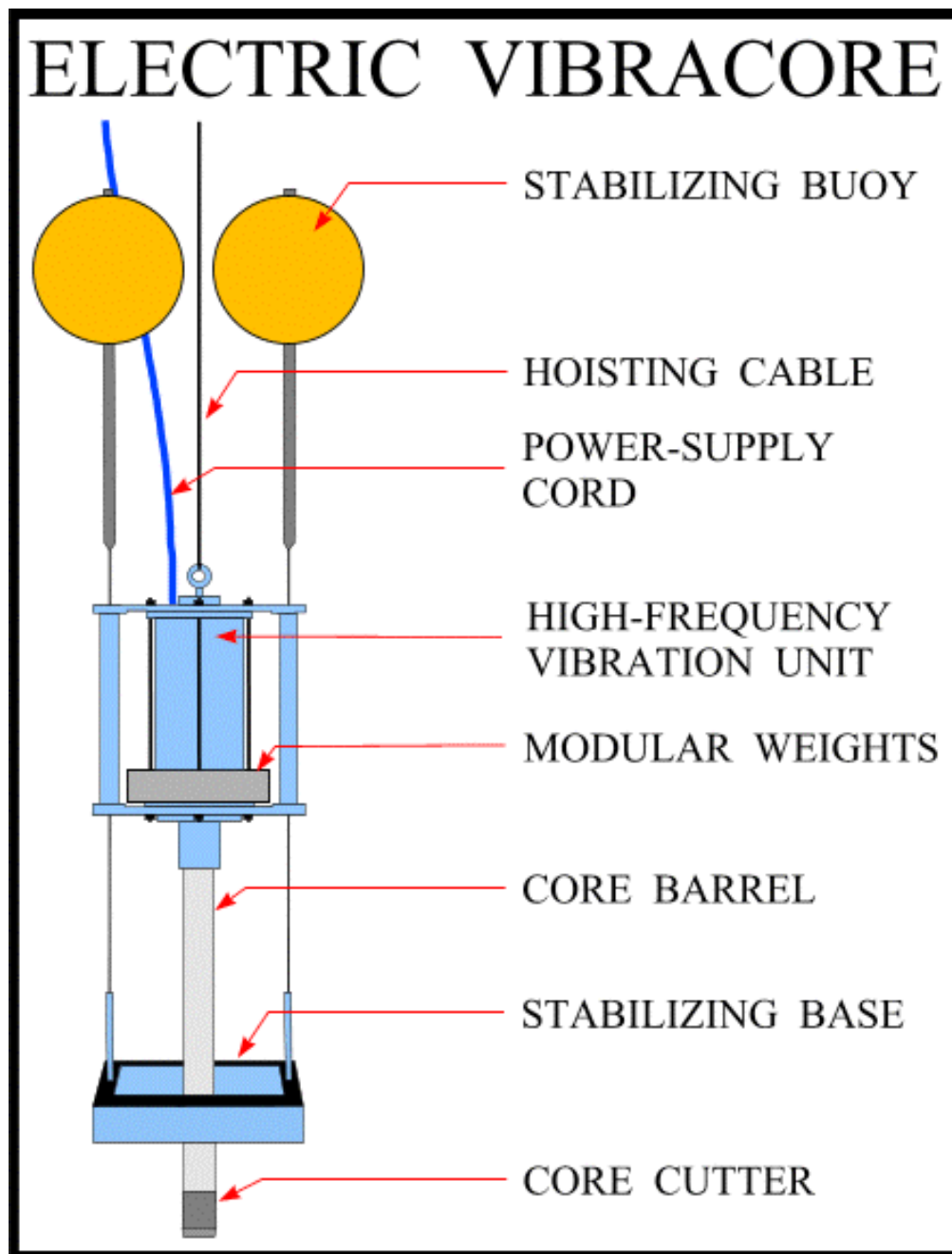
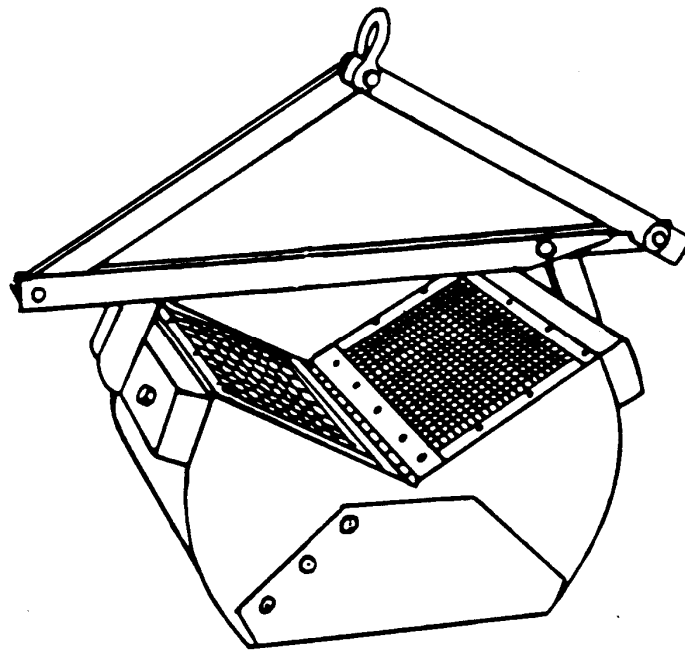


FIGURE 4
BOTTOM DREDGE GRAB SAMPLER



SOP APPROVAL FORM

TETRA TECH EM INC.

ENVIRONMENTAL STANDARD OPERATING PROCEDURE

RECORDING OF NOTES IN FIELD LOGBOOK

SOP NO. 024

REVISION NO. 1
May 18, 1993

Last Reviewed: December 2008



Quality Assurance Approved

December 5, 2008

Date

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Title: Recording of Notes in Field Logbook	Revision No. 1, May 18, 1993 Last Reviewed: December 2008

1.0 BACKGROUND

The field logbook should contain detailed records of all the field activities, interviews of people, and observations of conditions at a site. Entries should be described in as much detail as possible so that personnel can accurately reconstruct, after the fact, activities and events during their performance of field assignments. Field logbooks are considered accountable documents in enforcement proceedings and may be subject to review. Therefore, the entries in the logbook must be accurate and detailed; and they must reflect the importance of the field events.

1.1 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide guidance to ensure that logbook documentation for any field activity is correct, complete, and adequate. Logbooks are used for identifying, locating, labeling, and tracking samples. A logbook should document any deviations from the project approach, work plans, quality assurance project plans, health and safety plans, sampling plans, and any changes in project personnel. They also serve as documentation of any photographs taken during the course of the project. In addition, the data recorded in the logbook may assist in the interpretation of analytical results. A complete and accurate logbook also aids in maintaining good quality control. Quality control is enhanced by proper documentation of all observations, activities, and decisions.

1.2 SCOPE

This SOP establishes the general requirements and procedures for recording notes in the field logbook.

1.3 DEFINITIONS

None

1.4 REFERENCES

Compton, R.R. 1985. *Geology in the Field*. John Wiley and Sons. New York, N.Y.

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1.5 REQUIREMENTS AND RESOURCES

The following items are required for field notation:

- Field logbooks
- Ballpoint pens with permanent ink
- 6-inch ruler (optional)

Field logbooks should be bound (sewn) with water-resistant and acid-proof covers; they should have preprinted lines and wide columns. They should be approximately 7 1/2 by 4 1/2 inches or 8 1/2 by 11 inches in size. Loose-leaf sheets are not acceptable for field notes. If notes are written on loose paper, they must be transcribed as soon as possible into a regular field logbook by the same person who recorded the notes.

Logbooks can be obtained from an individual's office supply room or directly from outside suppliers. Logbooks must meet the requirements specified in this SOP and should include preprinted pages that are consecutively numbered. If the numbers must be written by hand, the numbers should be circled so that they are not confused with data.

2.0 PROCEDURES

The following subsections provide general guidelines and formatting requirements for field logbooks, and detailed procedures for completing field logbooks.

2.1 GENERAL GUIDELINES

- A separate field logbook must be maintained for each project. If a site consists of multiple subsites, designate a separate logbook for each subsite. For special tasks, such as periodic well water-level measurements, data from multiple subsites may be entered into one logbook that contains only one type of information.
- All logbooks must be bound and contain consecutively numbered pages.
- No pages can be removed from the logbook for any purpose.

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- All field activities, meetings, photographs, and names of personnel must be recorded in the site logbook.
- Each logbook pertaining to a site or subsite should be assigned a serial number based on the date the logbook is issued to the project manager. The first issued logbook should be assigned number 1, the next issued logbook assigned number 2, and so on. The project manager is to maintain a record of all logbooks issued under the project.
- All information must be entered with a ballpoint pen with waterproof ink. Do not use pens with “wet ink,” because the ink may wash out if the paper gets wet. Pencils are not permissible for field notes because information can be erased. The entries should be written dark enough so that the logbook can be easily photocopied.
- Do not enter information in the logbook that is not related to the project. The language used in the logbook should be factual and objective.
- Begin a new page for each day’s notes.
- Write notes on every line of the logbook. If a subject changes and an additional blank space is necessary to make the new subject title stand out, skip one line before beginning the new subject. Do not skip any pages or parts of pages unless a day’s activity ends in the middle of a page.
- Draw a diagonal line on any blank spaces of four lines or more to prevent unauthorized entries.

2.2 LOGBOOK FORMAT

The layout and organization of each field logbook should be consistent with other field logbooks. Guidelines for the cover, spine, and internal pagination are discussed below.

2.2.1 FORMAT OF FIELD LOGBOOK COVER AND SPINE

Write the following information in clear capital letters on the front cover of each logbook using a Sharpie® or similar type permanent ink marker:

- Logbook identification number
- The serial number of the logbook (assigned by the project manager)
- Name of the site, city, and state
- Name of subsite if applicable
- Type of activity

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- Beginning and ending dates of activities entered into the logbook
- “Tetra Tech EM Inc.” City and State
- “REWARD IF FOUND”

Some of the information listed above, such as the list of activities and ending dates, should be entered after the entire logbook has been filled or after decision that the remaining blank pages in the logbook will not be filled.

The spine of the logbook should contain an abbreviated version of the information on the cover: for example, “1, Col. Ave., Hastings, 5/88 - 8/88.”

2.2.2 First Page of the Field Logbook

Spaces are usually provided on the inside front cover (or the opening page in some logbooks), for the company name (“Tetra Tech EM Inc.”), address, contact name, and telephone number. If preprinted spaces for this information are not provided in the logbook, write the information on the first available page.

2.3 ENTERING INFORMATION IN THE LOGBOOK

Enter the following information at the beginning of each day or whenever warranted during the course of a day:

- Date
- Starting time
- Specific location
- General weather conditions and approximate temperature
- Names of personnel present at the site. Note the affiliation(s) and designation(s) of all personnel
- Equipment calibration and equipment models used.
- Changes in instructions or activities at the site
- Levels of personal protective clothing and equipment

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- A general title of the first task undertaken (for example, well installation at MW-11, decon at borehole BH-11, groundwater sampling at MW-11)
- Approximate scale for all diagrams. If this can't be done, write "not to scale" on the diagram. Indicate the north direction on all maps and cross-sections. Label features on each diagram.
- Corrections, if necessary, necessarily including a single line through the entry being corrected. Initial and date any corrections made in the logbook.
- After last entry on each page, initials of the person recording notes. No information is to be entered in the area following these initials.
- At the end of the day, signature of the person recording notes and date at the bottom of the last page. Indicate the end of the work day by writing "Left site at (time)." A diagonal line must be drawn across any remaining blank space at the bottom of this last page.

The following information should be recorded in the logbook after taking a photograph:

- Time, date, location, direction, and, if appropriate, weather conditions
- Description of the subject photographed and the reason for taking the picture
- Sequential number of the photograph and the film roll number or disposable camera used (if applicable)
- Name of the photographer.

The following information should be entered into the logbook when collecting samples:

- Location description
- Name(s) of sampler(s)
- Collection time
- Designation of sample as a grab or composite sample
- Type of sample (water, sediment, soil gas, etc.)
- On-site measurement data (pH, temperature, specific conductivity)
- Field observations (odors, colors, weather, etc.)
- Preliminary sample description
- Type of preservative used
- Instrument readings.

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If pre-printed field data forms are available (forms such as the micropurge field data collection form), data should be entered on these pre-printed forms rather than into field logbooks. Note in the logbook that the field data are recorded on separate forms.

2.4 PRECAUTIONS

Custody of field logbooks must be maintained at all times. Field personnel must keep the logbooks in a secure place (locked car, trailer, or field office) when the logbook is not in personal possession.

Logbooks are official project documents and must be treated as such.